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1. Introduction

1.1 Overview of EPA's Selected Remedy and the Performance Standards

In March 2016, EPA issued the Record of Decision (ROD) for the lower 8.3 miles of the Lower Passaic River, part of the Diamond Alkali Superfund Site. In accordance with Section 12.5 of the ROD, EPA has developed the engineering performance standards identified below to inform design and implementation of EPA's selected remedy so as to achieve the remedial action objectives (RAOs) set forth in the ROD and to minimize short-term impacts to the surrounding community. In addition, these standards are intended to promote accountability with stakeholders and conformance with the action-specific applicable or relevant and appropriate requirements (ARARs).

The engineering performance standards include: 1) The Performance Standard for Cap Design and Construction; 2) The Resuspension Performance Standards for Dredging and Capping; and, 3) The Productivity Performance Standards for Dredging and Capping. The major components of the selected remedy as stated in the ROD and how the engineering performance standards are expected to apply to them are described below.

- "An engineered cap will be constructed over the river bottom of the lower 8.3 miles, except in areas where backfill may be placed because all contaminated fine-grained sediments have been removed. The engineered cap will generally consist of two feet of sand and may be armored where necessary to prevent erosion of the sand." The two foot sand cap with armoring identified by EPA is conceptual and the performance standard for cap design and construction (described in Chapters 2 and 3) will provide flexibility to the remedial design (RD) Team to design and deploy a cap using proven approaches that provides protection from risks posed by the contaminated sediments equivalent to EPA's conceptual design. In other words, the standard will be performance-oriented rather than prescriptive.
- "Before the engineered cap is installed, the river will be dredged bank to bank (approximately 3.5 million cubic yards) so that the cap can be placed without increasing the potential for flooding. Depth of dredging is estimated to be 2.5 feet, except in the 1.7 miles of the federally authorized navigation channel closest to Newark Bay." EPA's conceptual design is based on an estimated dredging depth of 2.5 feet above river mile (RM) 1.7; 20 feet below mean low water (MLW) between RM 0.6 and RM 1.7; and 30 feet below MLW between RM 0 and RM 0.6, resulting in a removal volume of 3.5 million cubic yards. The RD Team may propose an equivalent cap that results in a smaller sediment removal volume, provided that it is protective, achieves the required depths of the navigation channel below RM 1.7, and does not increase the existing flooding potential of the Lower Passaic River. The performance standard for cap design and construction will enable the RD Team to achieve these ROD requirements.
- "The remedy will include sufficient dredging and capping to allow for the continued commercial use of a federally authorized navigation channel in the 1.7 miles of the river closest to Newark Bay and to accommodate reasonably anticipated future recreational use above RM 1.7." The RD Team may select the means and methods to dredge and cap the contaminated sediments in the lower 8.3 miles within the framework of demonstrated approaches; however, design and implementation will be guided by the requirements of the three engineering performance standards described in Chapters 2 through 5.
- "Dredged materials will be barged or pumped to a sediment processing facility in the vicinity of the Lower Passaic River/Newark Bay shoreline for dewatering. Dewatered materials will be

transported to permitted treatment facilities and landfills in the United States or Canada for disposal." EPA expects a sediment processing facility to be designed and built in the vicinity of the Lower Passaic River/Newark Bay shoreline for dewatering the dredged materials. The dredged materials will be transported to this facility via barge or pipeline. The dewatered materials will then be transported by road, rail or marine transport to permitted treatment facilities and landfills in the United States or Canada for disposal. In addition, the sediment processing facility is expected to have sufficient capacity to preclude limitations on the dredging and capping operations (see the productivity performance standards for dredging and capping described in Chapters 2 and 5).

- "Mudflats dredged during implementation of the remedy will be covered with an engineered cap consisting of one foot of sand and one foot of mudflat reconstruction (habitat) substrate." The performance standard for cap design and construction will serve to guide the selection of means and methods to reconstruct the mudflats.
- "Institutional controls will be implemented to protect the engineered cap." EPA will consult with NJDEP and work with the stakeholders to specify the deed restrictions and other legal criteria for the institutional controls. The engineering performance standards do not specify the requirements for the institutional controls but the design for the engineered cap must comply with them when ultimately specified.
- "Long-term monitoring and maintenance of the engineered cap will be required to ensure its stability and integrity. Long-term monitoring of fish, crab and sediment will also be performed to determine when interim remediation milestones, remediation goals and remedial action objectives are reached. Other monitoring, such as water column sampling, will also be performed." The performance standard for cap design and construction specifies the types of measurements and their frequency for long-term monitoring and maintenance of the engineered cap. Requirements for long-term monitoring of fish, crab, and sediment will be specified in Site Wide Monitoring Plan to be submitted as part of the design.

1.2 Rationale for Implementation of the Performance Standards

The Remedial Action is expected to achieve the following RAOs as stated in the ROD:

1. Reduce cancer risks and noncancer health hazards for people eating fish and crab by reducing the concentration of contaminants of concern (COCs) in the sediments of the lower 8.3 miles.
2. Reduce the risks to ecological receptors by reducing the concentration of COCs in the sediments of the lower 8.3 miles.
3. Reduce the migration of COC-contaminated sediments from lower 8.3 miles to upstream portions of the Lower Passaic River and to Newark Bay and the New York-New Jersey Harbor Estuary.

Placement of a bank-to-bank engineered cap over the contaminated sediments of the lower 8.3 miles and compliance with the Performance Standard for Cap Design and Construction will help achieve all of the RAOs. The goals of the Performance Standard for Cap Design and Construction are to guide the RD Team's technical approach so that (1) it meets or exceeds the requirements of the USACE and EPA capping guidance for erosion protection, chemical isolation, bioturbation, consolidation, scour due to propeller wash, ice rafting, and ice jams and (2) the installed cap based on such a design does not result in measurable additional flooding in the Lower Passaic River.

Compliance with the Resuspension Performance Standards for dredging and capping will also help achieve the third RAO. The goal of the Resuspension Performance Standard for Dredging and Capping is to guide the remedial design in limiting migration of COCs from the dredging operations in the lower 8.3 miles to the upper nine miles and to Newark Bay and the New York-New Jersey Harbor Estuary. In addition, these standards together will serve to verify that the various cap layers and their design thicknesses will be placed as intended in the desired locations to secure the long-term performance and effectiveness of the cap.

The goal of the Productivity Standards for Dredging and Capping is to maintain dredging and cap placement operations to be conducted by contractors at an appropriate pace over the planned duration for the selected remedy as outlined in the ROD, consistent with long-term projections of sediment bed and fish recovery.

1.3 Interaction among the Performance Standards

The Engineering Performance Standards have been designed to balance each other, with each standard setting the requirements that could potentially impact those necessary for the other two performance standards. Previous related experience and lessons learned on the Hudson River PCBs Superfund Site have shown that that it is necessary to make achievement of the Productivity Standards for Dredging and Capping subordinate to the other two standards, as discussed below.

1. The Performance Standard for Cap Design and Construction – meeting this standard is critical to achieving the long-term remedial goals of the selected remedy concerning protection and reduction of risks to human health and the environment. The Productivity Performance Standards shall not be achieved at the expense of this standard.
2. The Resuspension Performance Standards for Dredging and Capping – meeting these standards will prevent short-term releases from affecting the long-term remedial goals of the dredging and capping program and limit upstream and downstream migration of COCs. The Productivity Performance Standards shall not be achieved at the expense of this standard.
3. The Productivity Performance Standards for Dredging and Capping – meeting these standards is desirable to complete the remedial action in the time estimated in the ROD, thereby reducing costs and short term impacts to the river and adjacent communities. However, adherence shall not come at the expense of the Performance Standard for Cap Design and Construction or Resuspension Performance Standards for Dredging and Capping.

1.4 Document Organization

This document is organized as follows:

Chapter 2 - Statements of the Performance Standards presents concise descriptions of the statements of the three engineering performance standards, including the criteria to be met, specification of the physical or chemical parameters (or both) that must be measured and the locations and timing of these measurements, and, identification of the required responses or corrective actions to be taken when certain conditions are encountered during implementation.

Chapter 3 - Performance Standard for Cap Design and Construction, Chapter 4 - Resuspension Performance Standards for Dredging and Capping, and Chapter 5 - Productivity Performance Standards for Dredging and Capping, describe the bases for each of these standards including the technical background and approach and supporting analyses, and how each of these standards will be implemented.

Chapter 6, References: presents a list of references cited in this document.

2. Statements of the Performance Standards

2.1 Principles for the Development of the Performance Standards

The fundamental principles supporting EPA's development of the engineering performance standards are intended to result in a set of performance-oriented provisions that will guide the contaminated sediment remedial design so that the cleanup meets the objectives of the ROD.

The principles for development of the engineering performance standards include the following:

1. The standards will be developed to assist in achieving the objectives of the ROD in protecting human health and the environment, while offering as much flexibility as practicable in the final remedial design and implementation.
2. The standards will be developed to be performance-oriented rather than prescriptive with regard to means and methods.
3. The standards will be developed to comply with federal and state action-specific and location-specific ARARs identified in the ROD. Where no ARARs exist, other suitable guidance will be applied.
4. The standards will be developed to include goals to be achieved and incorporate best management practices based on the lessons learned from the environmental dredging pilot study, the site-specific removal actions and other major contaminated sediment remediation projects that have been completed or are being implemented.
5. The standards will be developed to include adaptive management during implementation of the selected remedy (see Section 2.5).
6. The standards will be designed to work both together and individually to achieve the overall goals of the project.

2.2 Statement of the Performance Standard for Cap Design and Construction

The statement of the Performance Standard for Cap Design and Construction provided below is a work in progress that will be refined and revised in an iterative manner over the next several months based on the results obtained from the supporting analyses and evaluations that are in progress as well as on pertinent observations from other contaminated sediment remediation projects. The statement may be further modified after the results of the Evaluation Report from the Pre-Design Investigation conducted become available and after the remedial design plans and specifications are finalized.

<u>Criteria to be met</u>

1. Cap must be placed in two or more lifts after sufficient dredging without increasing the current flooding potential of the LPR. The first lift is to stabilize dredging residuals and cover exposed contaminated sediment surface; subsequent lifts are to provide chemical isolation, erosion protection and a clean surface that minimizes recontamination. Stabilization of dredging residuals in a certification unit (CU) must be completed immediately after EPA's acceptance of the dredged surface in order to minimize resuspension. Subsequent lifts must be placed in dredged CUs no later than the end of each construction season to prevent the cap from damage

by significant storms. A significant storm is defined as a "to be determined" (TBD)-year return flow event (e.g., 25).

2. Cap must be able to withstand a 100-year storm event and shear stresses induced by propeller wash from vessel traffic, ice rafting and ice jams without a "measurable loss" and without allowing Contaminants of Concern (COCs) to be released into the LPR. Measureable loss is defined as a loss of more than 3 inches of cap thickness over a contiguous 4,000 square foot area or a contiguous area representing over 20 percent of a CU, whichever is less, considering the accuracy of the measurement technique and the nature of the cap surface. COCs refer to the four contaminants with Remediation Goals (RGs) defined in the ROD (i.e., 2,3,7,8-TCDD, Total PCBs, Mercury, Total DDx).
3. Cap surface concentration of COCs in the top six inches immediately after cap placement in a CU must be TBD [e.g., Weighted average across the CU does not exceed 20 percent of RGs].
4. Cap surface concentration of COCs in the top six inches must be no more than TBD percent of the RGs at the end of construction (e.g., weighted average across each half-RM).
5. Post-placement cap measurements (see below) must demonstrate that the engineered cap meets or exceeds design specifications.
6. Final cap surface elevation must be at or below the pre-dredging baseline sediment surface elevation over greater than 95 percent of the area of the lower 8.3 miles. The baseline surface elevation is based on the bathymetry for 201x before the start of construction.
7. The thickness and composition of the placed chemical isolation layer must be adequate to prevent breakthrough of COCs into the bioturbation zone for at least TBD (e.g., 250) years. Breakthrough is defined as the presence of detectable concentrations of COCs in the portion of the cap immediately above the chemical isolation layer.

Assumptions

1. Cap design is based on and consistent with EPA and USACE capping guidance (Guidance for In Situ Subaqueous Capping of Contaminated Sediments [Palermo et al., 1998a]; Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In Situ Subaqueous Capping of Contaminated Sediments (Palermo et al., 1998b); Contaminated Sediment Remediation Guidance for Hazardous Waste Sites [USEPA, 2005]).
2. COC concentration at the post-dredging surface is known from the pre-design investigation. Sediment core samples collected during the pre-design investigation must have sufficient lateral spacing and vertical resolution to allow for this determination within acceptable tolerances and which allows for design of the chemical isolation layer of the cap consistent with EPA and USACE capping guidance.
3. Backfill is placed between RM 0 and RM 1.7 provided targeted post-dredging elevation is at a clean boundary; otherwise an engineered cap must be placed. A clean boundary is defined as that elevation below which the sediment in a CU is free of any contamination.

Measurements

1. Measurement of the dredged surface in each CU.
2. Placed thickness of various cap layers immediately after construction (spacing of measurements TBD)
3. Placed thickness of mudflat reconstruction substrate immediately after construction (spacing of measurements TBD)
4. Elevation of the cap surface (based on the need to maintain the cap in perpetuity).

a. Immediately after placement (baseline)
b. One year after placement
c. After significant storm event
d. After construction is complete
e. At 5 year intervals for at least 15 years and then at 10 year intervals thereafter

5. COC concentration, total organic carbon (TOC), total iron, and grainsize distribution in bioturbation/erosion protection layer (top 6 inches of cap) (based on the expectation that RODs for the other operable units of the Diamond Alkali Superfund Site will be in place within 15 years after construction of the selected remedy for the lower 8.3 miles).
   a. Immediately after placement (baseline)
   b. After significant storm event
   c. After first construction season
   d. After construction is complete
   e. At 5 year intervals for at least 15 years
6. Total Organic Carbon (TOC) content of placed chemical isolation layer immediately after placement is completed in a CU and for all subsequent sampling events.

Analyses and Evaluations

1. Appropriate size of a CU that readily allows for the successful implementation of the performance criteria for this standard without adversely affecting the Resuspension or Productivity Engineering Performance Standards. – TBD. Dredging of CUs in the navigation channel will require multiple passes. This is because the removal volume and therefore the time to reach the targeted dredge elevation for CUs below RM 1.7 is greater than the corresponding removal volume and time to reach the targeted dredge elevation for CUs above RM 1.7. Also, at the end of construction, the amount of deposition on top of the capped surface is generally much greater for CUs below RM 1.7 (i.e., 15 to 100 cm) as compared to the amount of deposition on top of the capped surface for CUs above RM 1.7 (i.e., 1 to 15 cm). The approach utilized by the RA Team must balance and optimize the competing requirements of the performance standards.
2. Type of grid and spacing for physical measurements – TBD (e.g., bathymetric measurements must achieve targeted dredge and cap layer elevations in greater than 95 of the area of a CU to be considered acceptable by EPA; placed cap layer thickness must be equal to or greater than the design thickness in greater than 95 of the area of a CU to be considered acceptable by EPA).
3. Type of grid and spacing for chemical analyses – TBD (e.g., a minimum of 5 surface sediment samples must be collected per acre and composited to determine COC surface sediment concentrations; aliquots must be collected from each 3 inch depth interval of the chemical isolation layer at a minimum of 5 horizontally distributed locations and composited to determine the TOC content).
4. Statistical acceptance criteria for physical measurements – TBD (e.g., weighted average across each half-RM).
5. Statistical acceptance criteria for chemical analyses – TBD (e.g., weighted average across each half-RM).

Required Response/Corrective Actions

1. If any COC cap surface concentration in any CU is greater than the limits set in criterion # 4 above at end of construction, the top 6 inches of the cap must be removed and replaced.

2. If the average elevation of the cap surface in any CU (or contiguous portion of a CU greater than 25 percent) is lower than the baseline in any subsequent scheduled measurement during the construction period by 6 inches or greater, the cause must be investigated by collection of cores.
   a. If the investigation reveals that the placed thickness of the cap layers is intact and the whole cap has settled due to consolidation of the underlying sediment then a new baseline must be established.
   b. If the investigation reveals that the placed thickness of the cap layers has eroded or been significantly reduced, the damaged areas must be restored to the design or placed thickness whichever is greater, within a timeframe acceptable to EPA.

2.3 Statement of the Resuspension Performance Standards for Dredg ing and Capping

The statement of the Resuspension Performance Standards for Dredging and Capping provided below is a work in progress that will be refined and revised in an iterative manner over the next several months based on the results obtained from the supporting analyses and evaluations that are in progress as well as on pertinent observations from other contaminated sediment remediation projects. The statement may be further modified after the results of the Evaluation Report from the Pre-Design Investigation conducted become available and after the remedial design plans and specifications are finalized.

<u>Criteria to be met</u>

1. This standard consists of multiple action levels which include both measured levels and calculated levels – (TBD)
2. Changes in the downriver water column concentration of COCs in the far-field to Newark Bay must not exceed the Upper Confidence Limit (UCL) of the mean baseline estimated value for the flow and tidal conditions, with consideration of the location of the dredging operation. This criterion shall be applied when dredging is performed at a distance of 500 m or greater upriver from RM 0 .
3. Changes in the upriver water column concentration of COCs in the far-field to the upper nine miles of the LPR must not exceed the UCL of the mean baseline estimated value for the flow and tidal conditions, with consideration of the location of the dredging operation. This criterion shall be applied when dredging is performed at a distance of 500 m or greater downriver from RM 8.3.
4. The measured concentrations of solids and COCs at downriver and upriver far-field stations are less than the UCL of the mean baseline concentrations. (Baseline concentrations are a function of river flow and tidal conditions.)
5. The measured concentrations of solids and COCs at downriver and upriver near-field stations are less than TBD percent (e.g., two standartd deviations above baseline average)
6. Speed of project vessels (dredging platform, tugs, and barges) and their movement shall be controlled (as per N.J.S.A. 12:7-45 Speed of Power Vessels and N.J.A.C. 13:82-1.7 Speed – NJ State Police Marine Services Bureau) so that they do not create excessive wakes and do not contribute to resuspension.
7. No dredging or capping will be performed in an area when the river velocity is more than four feet per second (see Attachment E for supporting analysis).
8. There are fixed and portable monitoring stations that measure concentrations of selected water quality parameters at near-field and far-field stations.
9. Stabilization of dredging residuals in a CU must be completed immediately after EPA's acceptance of the dredged surface in order to minimize resuspension. However, there must be

no placement of subsequent lifts of capping material in a CU when dredging is being performed in an adjacent CU or within a distance of 1000 feet upriver or downriver. Analysis of Hudson River Phase 1 dredging data and the 2005 Environmental Dredging Pilot Study on the LPR have shown that the majority of the dredging-related resuspended solids generally settle within 1000 feet of the dredging operation. The approach utilized by the RA Team must balance and optimize the competing requirements of the performance standards.

Assumptions

1. Surrogate measurements may be used to estimate resuspension.
2. The near-field stations are located approximately 300 to 400 feet upriver and downriver from the dredging operation
3. The far-field stations are located approximately between 700 feet and 800 feet upriver and downriver from the dredging operation
4. Dredging and capping operations may be conducted simultaneously in two or more reaches of the river

Measurements

1. Conductivity, temperature, water depth, TSS, acoustic backscatter and turbidity in the water column at fixed monitoring stations located at RM 0, RM 8.3, and selected roadway bridges.
2. Conductivity, temperature, water depth, TSS, acoustic backscatter and turbidity in the water column at portable near-field and far-field monitoring stations for the dredging operation.
3. Conductivity, temperature, water depth at dredging and capping platforms.
4. Water surface elevations at USGS Station No. 01389500 Passaic River at Little Falls, Dundee Dam, NOAA Belleville Station No. 8530591, NOAA Point No Point Station No. 8530743, RM 8.3, and RM 0.
5. Perform local bathymetric surveys at start and end of dredging for each CU being dredged and capped and at suitable intervals in between – TBD.
6. Conductivity, temperature, water depth, TSS and turbidity in the water column at portable near-field and far-field monitoring stations for the capping operation.
7. River discharge at USGS Station No. 01389500 Passaic River at Little Falls, Dundee Dam, RM 8.3, and RM 0.
8. Water column concentration of COCs at fixed stations located at RM 0 and RM 8.3. Additional modeling and analysis shall be used to determine optimal sampling design including: sampling method, vertical and horizontal ports for cross-section representation, number of samples per day, and tidal cycle consideration.

Analyses and Evaluations

1. Calculate mass removed from each CU being dredged using differences between local bathymetric surveys.
2. Calculate downriver flux of COCs to Newark Bay.
3. Calculate upriver flux of COCs to the upper nine miles of the LPR.
4. Calculate resuspension (COCs and TSS) at upriver and downriver near-field monitoring stations adjacent to dredging operation.
5. Calculate resuspension (COCs and TSS) at upriver and downriver far-field monitoring stations adjacent to dredging operation.

6. Calculate mass of capping material placed in each CU being capped using differences between local bathymetric surveys.

Required Response/Corrective Actions

1. If the measured water column concentrations of solids and COCs at downriver and upriver near-field stations are more than the UCL of the mean baseline concentrations (average over 24 hours), provide feedback to dredge operator(s) and implement best management practices. Notify EPA and NJDEP.
2. If the measured water column concentrations of solids and COCs at down river and upriver far-field stations are more than the UCL of the mean baseline concentrations (average over 48 hours), provide feedback to dredge operator(s), implement best management practices, and slow down the production rate for one or more of the simultaneous dredging operations. Notify EPA and NJDEP.
3. This corrective action shall be applied when dredging is performed at a distance of 500 m or greater upriver from RM 0. If changes in the downriver water column concentration of COCs in the far-field to Newark Bay, [flow/velocity-weighted concentration average] exceed the UCL of the mean baseline estimated value, modify the production rate for all of the simultaneous dredging operations or stop at least one of the simultaneous dredging operations, whichever results in faster compliance with the standard. The baseline estimated value is based on flow and tidal conditions along with consideration of the location of the dredging operations. Notify EPA and NJDEP.
4. This corrective action shall be applied when dredging is performed at a distance of 500 m or greater downriver from RM 8.3. If changes in the upriver water column concentrations of COCs in the far-field to the upper nine miles of the LPR, [flow/velocity-weighted concentration average] exceed the UCL of the mean baseline estimated value, modify the production rate for all of the simultaneous dredging operations or stop at least one of the simultaneous dredging operations, whichever results in faster compliance with the standard. The baseline estimated value is based on flow and tidal conditions along with consideration of the location of the dredging operations. Notify EPA and NJDEP.

2.4 Statement of the Productivity Performance Standards for Dredging and Capping

The statement of the Productivity Performance Standards for Dredging and Capping provided below is a work in progress that will be refined and revised in an iterative manner over the next several months based on results obtained from supporting analyses and evaluations that are in progress as well as on pertinent observations from other contaminated sediment remediation projects. The statement may be further modified after the results of the Evaluation Report from the Pre-Design Investigation become available and after the remedial design plans and specifications are finalized. Currently, the statements are based on Options 2a and 3a, which are the recommended productivity rates presented in Section 5.2.1.

Criteria to be met

1. Dredging operations will proceed without adversely affecting the resuspension or cap design and construction performance standards and while simultaneously fully complying with the quality of life performance standards for air quality, odor, noise, and lighting. If there is a conflict between the standards, the capping and resuspension performance standards will take

priority. The approach utilized by the RA Team must balance and optimize the competing requirements of the performance standards.

2. The cumulative annual dredging production will be as follows:
   - Year 1 – 350,000 in-situ cubic yards
   - Year 2 – 1,050,000 in-situ cubic yards
   - Year 3 – 1,750,000 in-situ cubic yards
   - Year 4 – 2,450,000 in-situ cubic yards
   - Year 5 – 3,150,000 in-situ cubic yards
   - Year 6 – All dredging is completed.
3. The upland processing system and all associated facilities must be sized appropriately to allow for periods of peak dredging production without becoming a limiting factor for the in-river construction activities.
4. The RA Team will provide a weekly target production schedule for the entire construction season prior to the start of each construction season.
5. Planned dredging and capping of CUs for each construction season must allow sufficient time for all open CUs to be capped and satisfy interim or final acceptance criteria prior to the start of the fish window. (see Performance Standard for Cap Design and Construction).
6. Opening of moveable bridges to allow passage of project vessels and dredging/capping equipment between river sections will comply with US Coast Guard regulations stated in 33 CFR §117.739 and allow for advance notification to AMTRAK, NJ Transit, and PATH railroads.

Assumptions

1. Production targets are based on a total removal volume of 3.5 million cubic yards (in-situ).
2. Each construction season consists of 35 weeks per calendar year, with an allowance of 3 non-consecutive weeks of downtime due to equipment breakdown or weather-related delays during that period.
3. In-river construction activities will be significantly curtailed or prohibited completely to allow for fish migration and spawning during fish windows imposed by NMFS and other agencies. A fish window of 17 consecutive weeks per calendar year was included in EPA's conceptual design in the ROD.
4. All dredging and capping operations must be conducted with sufficient advance notification to EPA, NJDEP, and local authorities so that commercial and recreational uses of the river can be safely accommodated to the extent practicable.
5. Dredging and capping operations may be conducted simultaneously in two or more reaches of the river.
6. No dredging or capping will be performed in areas where the river velocity is greater than 4 feet per second (see Attachment E for supporting analysis).

Measurements

1. Perform local bathymetric surveys at start and end of dredging and capping for each CU being dredged and capped and at suitable intervals in between – TBD.

Analyses and Evaluations

1. Calculate weekly productivity based on multi-beam bathymetric surveys.
2. Calculate monthly productivity based on multi-beam bathymetric surveys.
3. Calculate annual productivity based on multi-beam bathymetric surveys.

Required Response/Corrective Actions

1. If the average weekly productivity is less than TBD percent of planned production rate per week for 2 consecutive weeks, identify the primary factor(s) causing the delay and develop a plan to overcome the deficit. Notify EPA and NJDEP.
2. If the average monthly productivity is less than TBD percent of planned production rate per month, identify the primary factor(s) causing the delay, determine whether the annual production target is in jeopardy and implement a plan to overcome the deficit. Notify EPA and NJDEP.
3. {Need to add statement for capping after completion of evaluations}

2.5 Ongoing Evaluation of Dredging and Capping and Possible Refinements in Subsequent Years

As stated in Section 4.3 Adaptive Management of the ROD, "EPA expects that during implementation of the selected remedy for the lower 8.3 miles of the Passaic River, information and experience gained as a result of earlier stages of the implementation will inform later stages of the remedial action." At the end of each construction season, EPA will evaluate the results of the measurements and data collected by the RA Team to determine whether any of the engineering performance standards need to be adjusted or refined based on new information. As the dredging and capping progresses in different reaches of the river, EPA may also consider making modifications to the engineering performance standards during the construction season. However, implementation of any mid-season modifications will first be discussed with the RA Team to determine whether the appropriate resources (personnel, equipment, and materials) are readily available and that proposed changes would not disrupt planned activities.

3. Performance Standard for Cap Design and Construction

This chapter presents the basis for this standard including the technical background and approach and supporting analysis, and describes how this standard will be implemented.

3.1 Basis for the Performance Standard for Cap Design and Construction

3.1.1 Technical Background and Approach

Development of the Performance Standard for Cap Design and Construction started with an in-depth examination of caps that were designed and constructed for various relevant projects. This evaluation included consideration of the types of data and information that was collected and evaluated for these projects in order to establish precedent or rationale for the key elements of the standard. Among others, these projects included the RM 10.9 Removal Action, as well as major contaminated sediment remediation projects like the Hudson River PCBs Superfund Site and the Lower Fox River and Green Bay Site OUs 2 through 5. Pertinent details of these caps are presented below for comparison to the conceptual design in EPA's ROD.

For the RM 10.9 Removal Action, the Waterfront Permit Equivalent issued by NJDEP required that the top of cap elevation must be no higher than the original sediment surface elevation. In the vast majority of the RM 10.9 sediment excavation, the top of cap is actually lower in elevation than the original sediment surface because a 2-foot thickness of sediment was excavated, while the cap as designed and placed was 22 inches in thickness. The 22-inch cap cross-section design consists of an average of 10 inches of active layer material, geotextile, 12 inches of Type A (D_{50} = 4.5 inches) armor stone, and a thin sand layer just covering the top of the armor stone (River Mile 10.9 Removal Action Final Design Report, Lower Passaic River Study Area [CPG, 2013a]). However, in some near-shore areas, high sub-grade (i.e., very hard-packed material consisting of weathered stone, clay and cobble) prevented excavation of the full 2 feet of sediment. As a result of the hard subsurface material encountered in Cuts 4T, 6T, 8T, and 9T, dredging was unable to achieve the minimum acceptable depth (-1.5 feet) in some areas. In those areas, the cap design was modified to promote its protectiveness, even with a thinner profile, as indicated in Technical Memorandum – River Mile 10.9 Removal Action – High Sub-grade Cap Design (CPG, 2013b). The revised cap cross-section design for the high sub-grade areas consisted of a 6 inches of active material (i.e., the same sand/ AquaGate + PAC™ mixture as the standard RM 10.9 cap design), geotextile, 6 inches of Type B (D_{50} = 2 inches) armor stone, and a thin layer of sand just covering the top of the armor stone.

For the Upper Hudson River, the specific design objectives of the engineered caps are described in Section 2.6 of the Phase 2 Critical Design Elements (CDE) specified by EPA Region 2 (EPA, 2010a). Engineered caps were installed in certain dredged areas of the Upper Hudson River in accordance with the Residuals Performance Standard criteria (EPA, 2010b), to act as a physical barrier that both isolated and stabilized the residual sediments. EPA's CDE required development of several prototype caps which are presented in Table 3-1 below. The details of the design objectives, basis of design, and cap analysis can be found in Appendix F of GE's 2011 Final Design Report (GE, 2011a).

Table 3-1 Summary of Design for Phase 2 Prototype Caps

Cap Type	Area	Cap Materials and Thickness
Isolation Cap Type C, Medium- and Low-Velocity	Outside Navigation Channel, with average water velocities ≤ 5 feet per second (fps) based on a 100-year event	A minimum 9-inch isolation layer of Type 2 material with 2 percent organic carbon content
		A 6-inch armor layer of Type N material (see Specification Section 02206 [Backfill/Cap Material], Appendix 2)
Isolation Cap Type C, High-Velocity	Within Navigation Channel, or outside Navigation Channel with average water velocities > 5 fps based on a 100-year event	A minimum 9-inch isolation layer of Type 2 material with 2 percent organic carbon content
		A 6-inch armor layer of Type O material (see Specification Section 02206 [Backfill/Cap Material], Appendix 2)

For the engineered caps at the Fox River and Green Bay Site, the appropriate chemical isolation layer thickness was based on the PCB concentration in the top 6 inches of sediment immediately underlying the cap, consistent with the criteria specified in the ROD Amendment (EPA and WDNR, 2007) as listed below. It also included consideration of the pore water expelled as a result of cap induced consolidation of the underlying sediments.

"Cap A – Engineered caps of at least 3 inches of sand for chemical isolation: PCB concentrations will not exceed 50 ppm within the sediment profile and PCBs in the top 6 inches of sediment immediately beneath the cap will be less than 10 ppm.
Cap B – Engineered caps of at least 6 inches of sand for chemical isolation: PCB concentrations will not exceed 50 ppm within the sediment profile.
Cap C – Engineered caps of at least 6 inches of sand for chemical isolation: PCB concentrations exceeding 50 ppm buried within the sediment profile or in shoreline areas where dredging would result in instability. Note that although Caps B and C have the same chemical isolation layer thickness, Cap C has a more robust armor layer."

Several potential forms of erosion, including hydrodynamic flows, ice scour, wind-induced waves, and vessel-induced propeller wash and vessel wakes were evaluated for the cap design presented in Table 3-2 below.

Table 3-2 Summary of Engineered Cap Designs for Fox River OUs 2 through 5

Cap Type	Post-Cap Water Depth	Median Stone Size of Gravel Armor D_{50} (inches)	Minimum Layer Thicknesses			Minimum Total Cap Thickness (inches)
			Sand	Gravel Armor	Quarry Spall Armor (D_{50} = 6 to 9 inches; D_{50} shoreline = 8 to 10 inches)	
Cap A: PCB concentration in top 6 inches below cap < 10 ppm and < 50 ppm anywhere in depth profile						
Cap A1	3 to 4 feet	3	3	6	0	9

Cap A2	4 to 6 feet	1.5	3	4	0	7
Cap A3	> 6 feet	0.25	3	4	0	7
Cap B: PCB concentration in top 6 inches below cap > 10 ppm and < 50 ppm anywhere in depth profile						
Cap B1	3 to 4 feet	3	6	6	0	12
Cap B2	4 to 6 feet	1.5	6	4	0	10
Cap B3	> 6 feet	0.25	6	4	0	10
Cap C: PCB concentration > 50 ppm or in Federal Navigation Channel						
Cap C1	> 3 feet	1.5	6	3	12	21
Shoreline Caps						
OU 3/OU 4A	varies	1	3 to 6	3	18	24 to 27
OU 4B	varies	1	3 to 6	3	16	22 to 25

Considering normal overplacement allowances, the actual placed thickness of the various caps was greater than the values shown in Table 3-2.

The technical approach for the development of the Performance Standard for Cap Design and Construction considers all of the elements encompassed by EPA's conceptual design and the associated hydrodynamic modeling presented in the ROD, as well as erosion that may result from propeller wash. Erosion induced by propeller wash may occur from movements of project vessels during the remedial construction (dredging and capping platforms, tugs, and barges) as well as from commercial vessels that utilize the authorized federal navigation channel below RM 1.7 and must be considered in cap design.

Site-specific information regarding the number and types of commercial vessels that are utilized by various businesses that have berthing facilities will have to be obtained by the RD Team. While it is not possible at this time to identify the numbers and types of project vessels that may be used by the RA Team's contractors, certain assumptions can be made by the RD Team by examining the details about the vessels used for the Tierra Phase 1 Removal Action and the RM 10.9 Removal Action.

The text for this section has yet to be developed.

3.1.2 Supporting Analysis

The supporting analysis has not been performed at present and the text for this section has yet to be developed.

3.2 Implementation of the Performance Standard for Cap Design and Construction

3.2.1 Placement in Multiple Lifts

3.2.2 Cap Layers and Thicknesses

3.2.3 Cap Surface Concentrations of Contaminants at End of Initial Placement

3.2.4 Cap Surface Concentrations of Contaminants at End of Construction

3.2.5 Bathymetric Measurements and Coring

3.2.6 Monitoring and Maintenance

3.2.7 Recontamination of Cap over the Long-Term (?)

3.3 Reporting and Notification

3.3.1 Routine Reporting

3.3.2 Contingency Reporting

3.4 Additional Studies/Evaluations

4. Resuspension Performance Standards for Dredging and Capping

This chapter describes the basis for this standard including the technical background and approach and supporting analysis, and describes how this standard will be implemented.

4.1 Basis for the Resuspension Standards for Dredging and Capping

4.1.1 Technical Background and Approach

The resuspension performance standard is designed to ensure that the mass of contaminants lost via resuspension will be limited such that human health, biota and subsequent long-term recovery of fish body burdens will not be adversely impacted as a result of remedial operations. It is envisioned that the standard will have three main components that must be defined:

1. A set of contingency thresholds requiring additional monitoring or engineering controls to reduce the amount of resuspension to acceptable levels in the event that concentrations are found to increase toward the threshold or initial controls are insufficient.
2. Contaminant threshold concentration that will ensure that
    a. The amount of COCs mass lost during dredging or cap placement is within acceptable limits.
    b. The increase in TSS or COCs concentration in the river are within the natural variability of the river or within acceptable limits.
3. An effective monitoring plan.

The Resuspension Standard addresses two areas with respect to dredging and capping, the near-field area and the far-field area. The near-field area is defined as the region in the immediate vicinity or the remedial operation, extending from approximately 300 to 400 ft upstream to approximately 300 to 400 ft downstream of the remedial operation. This area represents the region of the water column most directly impacted by the remedial operation. The far-field area is the region upstream or downstream of the remedial operations depending on the tide – whether flood tide or ebb tide, located at least 1,000 ft upstream or downstream of the remedial operation. Typically, within this distance, the majority of particle settling from dredging-related and capping-related activities is expected to have occurred.

4.1.2 Supporting Analyses

Supporting analyses were conducted during preparation of the Resuspension Standard to address and resolve issues pertaining to the impact of dredging or cap placement and COCs transport from remedial operation areas to adjacent locations in the river. The supporting modeling analyses were performed with the models that had been used in the evaluation of alternatives to support the development of the ROD. Linked modeling components used in the evaluation of alternatives leading up to the ROD included hydrodynamic, sediment transport, organic carbon production and transport, and contaminant fate and transport models. Alternatives evaluated in support of the ROD included a No-Action alternative and three alternatives with active remediation, from which the alternative "Capping with Dredging for Flooding and Navigation" was selected and incorporated in the ROD.

The simulations performed for the active remedial alternatives involved running the model from 2013 (end of the calibration period) to July 2020 when construction was assumed to begin, then through the period of construction (December 2025 for the selected remedy) and for a period of 30 years after completion of construction. The hydrographs and tidal boundary conditions used for the alternatives were developed by repeating the model inputs (boundary inflows and tides) for the period October 1995 – October 2010 (water years 1996-2010) in 15-year cycles and appending them to the historical water year 1995 – 2013 inputs to generate one continuous simulation for the period of water years 1996 through 2064. The No-Action alternative is identical to the active remedial alternatives up to July 2020, and uses the same hydrographs and tidal boundary conditions as the active alternatives, but does not include any remediation during the period of construction for the three active remedial alternatives. Results from the No-Action alternative are used for comparison to results from the Selected Remedy, as described below. These analyses include:

- Evaluating the effect of sediment and contaminants released during dredging, with the objective of assessing what might be observed in results of monitoring upstream and downstream of dredging operations, which will provide a basis for assessing whether conditions during the actual construction are consistent with expected releases during dredging and identify time periods when corrective actions may be needed to bring construction performance back into the range of acceptable conditions.
- Evaluating the effect of resuspension of exposed sediment in the time period between dredging and capping, to assess the balance between the negative effect of resuspension of contaminated sediment while the cell is open versus the benefit of providing an opportunity for sediment and contaminants released from dredging nearby cells to deposit in the open cell and be sequestered under the cap rather than on top of the cap, had the cap been placed earlier.
- Quantifying the export of sediment and contaminants to areas upstream and downstream of the lower 8-mile reach, with the objective of understanding factors affecting the practicality of performing monitoring to determine mass export to areas upstream and downstream of the lower 8-mile reach of the LPR. Control of export of contaminants to the upper 9-mile reach and to Newark Bay is a goal of the remedy.

4.1.2.1 Effects of Releases of Sediment During Dredging

The transport and fate of sediment and contaminants released during dredging were assessed with model simulations, as described in Attachment A1 "Effects of Releases of Sediment During Dredging" and Attachment A2 "Effects of Releases of Contaminants During Dredging." As sediment is released to the water column during dredging, carbon and contaminants associated with the sediment are also released. Model simulations of the remedial alternatives for the lower 8.3 miles of the LPR assumed 3 percent of the mass of sediment, organic carbon and contaminants removed with dredging is released to the water column, with 1.5 percent released in the bottom layer and 1.5 percent released in the surface layer of the water column. In addition to comparing results of the Selected Remedy and No-Action simulations to assess the fate of sediment and contaminants released during dredging, simulations were also run with additional variables added to the code to numerically tag sediment and contaminants released during dredging. This was accomplished by creating a parallel set of variables to track only the sediment or contaminants released during dredging, while sediment and contaminants from all other sources (i.e. boundary inputs and resuspension of native sediment) were simulated in the standard variable used to calculate concentrations of each size class (for sediment) and contaminant in every grid cell in the water column and bed each time step through the simulation. Total sediment and contaminant concentrations are obtained by adding the concentrations in the original and new tagging variables.

Model simulation results for suspended sediment were used to evaluate: 1) spatial differences in concentrations upstream and downstream of dredging operations; and 2) differences in concentrations between the Selected Remedy and No-Action simulations. Simulated suspended sediment concentrations in grid cells upstream and downstream (e.g. 500 feet) of the dredging operations showed average differences between the No-Action and Selected Remedy model results of less than 5 mg/l. For the Selected Remedy simulation, comparisons of paired hourly results for grid cells upstream and downstream of the dredging operations showed small spatial gradients. These analyses suggest that suspended sediment measurements (or surrogates such as turbidity or acoustic backscatter) may be useful for detecting substantial excursions from expected conditions, but should not be expected to detect smaller deviations (e.g. a factor of two or three) from assumed sediment release rates associated with dredging operations.

Near-field spatial and/or temporal changes in SSC associated with sediment released during dredging vary with location within the river, dredging sequence, and in response to river flow and tidal conditions during the period of construction, which will need to be factored into the performance standards.

Use of additional variables to track sediment released during dredging provides an indication of the degree to which sediment originating from releases during dredging replaces native sediment in the overall sediment transport process (i.e. solids released during dredging represent concentrations greater than the difference between results from simulations with and without dredging). This leads to the conclusion that monitoring solids (or surrogates) will need to be supplemented with chemical measurements to evaluate compliance with acceptable construction performance.

Results from similar analyses with the contaminant fate and transport model present a different picture of conditions during dredging compared to the No-Action simulation results. Water column concentrations in model grid cells immediately upstream and downstream of the dredging operations show an increase in 2,3,7,8-TCDD concentrations of approximately a factor of four to eight compared to the No-Action simulation results. Tetra-PCB concentrations for the Selected Remedy also show increases relative to the No-Action simulation, but by smaller amounts, with increases by factors of 1.6 to 2.5. Spatial gradients of Tetra-PCBs from upstream to downstream of the dredging operation are relatively small, which is similar to the result for 2,3,7,8-TCDD.

Additional information regarding differences between potential monitoring locations upstream and downstream of dredging operations will be added when ongoing evaluations are completed.

4.1.2.2 Effect of Natural Resuspension in Dredged Areas Prior to Capping

In the time interval between dredging and capping, newly exposed sediments (which generally are more contaminated) are subject to resuspension due to ambient velocities exerting a shear stress on these previously buried sediments. On the other hand, the time interval between and completion of dredging and the start of capping provides an opportunity for sediment and contaminants released from dredging nearby cells to deposit in the open cell and be sequestered under the cap rather than on top of the cap, had the cap been placed earlier. Analyses were performed to evaluate how vertical contaminant concentration gradients might affect the contaminant resuspension flux in the period between dredging and capping, as compared to the period prior to dredging. The results of this analysis will be considered in developing performance standards related to the time span between completion of dredging and start of capping in a particular CU.

This evaluation considers two sets of information related to the changes in contaminant concentrations in surface sediments before and after dredging (but prior to capping): the first relies on vertical concentration profiles in sediment cores and the second considers contaminant concentrations in the bed at the time in the Selected Remedy model simulations when remediation is represented (i.e. between 2020 and 2025). The bed concentrations in the model at the depth of the dredge cut at the time of dredging are based on initial conditions developed from 2008 – 2013 coring data, and any changes computed due to contaminant transport caused by sediment deposition or erosion during the contaminant fate and transport (CFT) model simulation of the period from 2013 to the time of dredging. The CFT model initial conditions were developed using an averaging procedure within discrete geomorphic units (e.g. broad shoals, smooth channel, scoured channel) that allowed a continuous concentration surface to be estimated for each contaminant. Because the concentrations from the model can represent spatial averages over several acres, the concentration data from individual sediment cores and averages across model grid cells are not directly comparable.

The first approach, using individual core data, is currently underway. Details of the core data analysis and comparisons of the conclusions of the two analyses/approaches will be included in the next version of this document.

Observations drawn from the analysis of the contaminant results from the CFT model are:

- In approximately 65 percent of the cells, post-dredging exposed 2,3,7,8-TCDD concentrations are higher than the average concentrations in the top 15 cm just before dredging (July 1st, 2020), and concentrations are higher by more than a factor of 2 in approximately 50 percent of the cells. In approximately 10 percent of the cells, concentrations are higher by more than a factor of ten.
- Concentrations decreased by less than a factor of 2 in approximately 10 percent of the grid cells and decreased by between a factor of 2 and 10 in 15 percent of the cells. Decreases by more than a factor of 10 were calculated in 10 percent of the cells.

The significant increase in concentration in the period between dredging and capping (compared to the pre-dredging condition) over such a large fraction of the area indicates that control of dredging residuals is critical and the duration that these elevated concentrations are exposed prior to capping should be minimized.

4.1.2.3 Cumulative Load

In addition to reductions in ecological and human health risks in the LPR, an objective of the Selected Remedy is a reduction in the transport of contaminants to Newark Bay and the Upper 9-miles of the LPR. Part of the evaluation of remedial alternatives was consideration of the effect of each alternative on contaminant export to Newark Bay and the Upper 9-miles of the LPR over longterm (i.e. 30 years) and shorter term (i.e. during construction) timeframes. An analysis of gross and net solids and contaminant loads from the Lower 8.3 mile reach to the Upper 9 miles and Newark Bay for the No Action and Selected Remedy simulations is presented in Attachment B “Cumulative Load Calculations”. As part of the evaluation of the Selected Remedy it was recognized that longterm reductions in contaminant loads would be achieved despite short term increases during the construction period. Because the analysis of contaminant loads to the Upper 9-miles and Newark Bay is of primary interest in setting performance standards, only contaminant loads are discussed in this section. Details of the results of the analysis of cumulative sediment loads are presented along with a more-detailed discussion of contaminant loads in Attachment B “Cumulative Load Calculations”.

Contaminant Fluxes during the Period of Construction

RM 8.3

When dredging begins in July 2020 at RM 8.3, there is a noticeable increase in both the gross upstream and gross downstream contaminant fluxes, compared to the period prior to dredging and compared to the No-Action simulation results. In all but the July – December 2020 period, the net flux remains in the downstream direction, and in that period, net flux for mercury and Total DDX continue in the downstream direction, however the net upstream fluxes calculated for 2,3,7,8-TCDD and Total PCBs are in the upstream direction. In the July – December 2020 period, dredging is simulated near the RM 8.3, which coupled with enhanced upstream transport due to estuarine circulation under low-flow conditions, results in an increase in the gross upstream contaminant flux. For each of these four contaminants, the difference between the cumulative net fluxes in the Selected Remedy and No-Action simulations decreases each year, suggesting that contaminants transported upstream during the early period of construction are later remobilized and transported back downstream of RM 8.3.

Under the low-flow conditions at the start of the Selected Remedy simulation, when dredging is located near the upstream limit of the Lower 8-mile reach, the net fluxes of contaminants at RM 8.3 are less than 5 percent of the gross upstream and gross downstream fluxes, indicating that accurately measuring the net flux will be challenging. In the simulation of 2021 - 2023, as dredging moves in the downstream direction away from RM 8.3, annual net fluxes represent between 50 and 200 percent of the gross upstream flux, making evaluation of the net flux more practical.

Transport to Newark Bay

Two locations were considered for transport out of the Lower 8-miles, with the first along the diagonal administrative boundary of the LPRSA, and a second at RM 0.8, just upstream of where the river widens approaching Newark Bay, which would be a more practical cross section for attempting to conduct monitoring for evaluating contaminant fluxes.

At RM 0.8, the start of construction results in an initial increase in the gross upstream and gross downstream fluxes and a more noticeable(compared to RM 8.3) increase in the net downstream flux during the period of construction for each of the four contaminants (2,3,7,8-TCDD, Total PCBs, mercury and Total DDX. Although the cumulative net contaminant flux in the last year of construction remains greater for the Selected Remedy simulation (compared to No-Action), the annual net flux for year 2025 for the Selected Remedy is equal to or less than the flux for the No Action simulation. This shows the beginning of the benefit of the remedy, although more time is required to offset the initial increase in the net flux calculated at the beginning of the construction period.

Temporal changes in contaminant fluxes at RM 0 are similar to results at RM 0.8, although the magnitude of the gross upstream and gross downstream fluxes at RM 0 are generally between 5 and 8 times greater than the gross fluxes at RM 0.8.

Attachment B "Cumulative Load Calculations" includes details on post-construction contaminant transport, which show the cumulative benefit of the remedy in reducing contaminant transport out of the Lower 8-Mile remedy area. The initial increase in net contaminant flux to Newark Bay is offset over time by lower annual fluxes following construction, and the cumulative net flux to Newark Bay is less following implementation of the Selected Remedy, compared to the No Action simulation results.

4.1.2.4 Contaminant Surrogate Study

During dredging, immediate feedback to dredgers is needed to determine compliance with near-field and far-field criteria for allowable release. 2,3,7,8-TCDD is the primary risk-driving contaminant in the Lower Passaic River. The release of 2,3,7,8-TCDD during dredging needs to be monitored for compliance. However, the laboratory turnaround time for 2,3,7,8-TCDD is approximately a few days to 3 weeks. Therefore, a surrogate contaminant or an alternative analytical method for 2,3,7,8-TCDD is needed.

A surrogate contaminant should have similar release profile, i.e. change of water column concentration with time, as 2,3,7,8-TCDD during sediment disturbance. The release profile of a contaminant is regulated by its concentration in the sediments as well as its desorption rate from sediment particles to water column. Therefore, for a chemical to serve as an appropriate surrogate for 2,3,7,8-TCDD, its concentration must be correlated to 2,3,7,8-TCDD in the sediments that will be removed, and its desorption rate must approximate that of 2,3,7,8-TCDD as well.

To obtain a surrogate contaminant, a literature review of desorption rates for various contaminants was performed to evaluate potential contaminant surrogates. In addition, a consultation with technical experts, such as Dr. Donald Hayes (University of Nevada, Las Vegas) was also pursued. Existing Lower Passaic River data for water column and surface sediment were also examined to determine the correlation between 2,3,7,8-TCDD and other contaminants.

Based on the literature review, consultation with experts and the existing Lower Passaic River data, organic compounds which have similar hydrophobicity as 2,3,7,8-TCDD, such as PCBs, can be suitable surrogates to monitor the release of 2,3,7,8-TCDD. In addition, PCBs are collocated with 2,3,7,8-TCDD in the sediments that are targeted for dredging and are also correlated in the existing baseline water column observations. Furthermore, extensive experience on the Hudson River indicates that laboratory turn-around time for PCB Aroclors could be as rapid as 24 hours. While the release of metals, including mercury, lead and copper is also expected during dredging, metals are not good surrogates for 2,3,7,8-TCDD due to their different chemical characteristics, release mechanisms and lack of correlation to 2,3,7,8-TCDD in the sediments. Even if a good surrogate is identified, some 2,3,7,8-TCDD analysis will still be needed at the beginning of the remedial action to ensure that relationships developed between 2,3,7,8-TCDD and the surrogate during the design continue to remain valid during active remediation. Note that 2,3,7,8-TCDD will still be analyzed as part of the overall monitoring program but its analysis requires several days or weeks of laboratory work, so it will not be used to provide immediate feedback to dredgers on their operations.

Detailed discussions can be found in Attachment C "Contaminant Surrogate Evaluation".

4.1.2.5 Resuspension of Contaminated Sediment during Cap Placement

During cap placement, resuspension, volatilization, or other movement of chemical contaminants can occur. The goal of the performance standard for loss prevention during cap placement is to limit upriver and downriver migration of COCs and clean cap materials from the capping operations in the lower 8.3 miles to the upper nine miles and to Newark Bay and the New York-New Jersey Harbor Estuary. These releases will be captured at the near-field and far-field monitoring stations. There are no standardized methods to predict the degree of contaminated sediment resuspension and release of contaminants resulting from cap placement. A literature review was conducted to examine resuspension of sediment during cap placement for different projects.

Based on the available literature (Lyons, et al., 2006; Fredette, et al., 2002; Dunn et al., 2005), the release of contaminants from suspended sediments during cap placement was related to the placement methods and the concentration of the sediment being exposed after dredging. The data indicated that most significant releases occurred with the first capping layer placement and the magnitude of contaminant resuspension decreased with successive capping layers. In general, the concentration decreased to baseline concentration within 2 hours. The resuspension during capping may be minimized by placing cap material in lifts, where the first lift provides a uniform layer of clean material using techniques that minimize sediment disturbance and subsequent lifts are placed more aggressively once contaminated sediment is covered.

Detailed discussions can be found in Attachment D "Resuspension During Cap Placement".

4.2 Implementation of the Resuspension Standards for Dredging and Capping

This section contains details of the implementation of the standard, including monitoring for parameters of concern. Daily measurements of suspended solids and COCs concentrations can then be compared with the appropriate action levels of the Resuspension Standard thresholds. Load-based criteria require more than a measure of concentration, since flow must be incorporated into the load estimate. Comparisons to the resuspension criteria must be made on a daily basis for each of the near-field and far-field stations.

4.2.1 Estimation of Baseline Loads to Upper Nine Miles and Newark Bay

During the remedial design period, the design contractor will set up a baseline monitoring program designed to determine concentrations and loads of solids and contaminants at the far-field stations. The monitoring program will collect water column samples representing a range of the following factors:

- Dundee Dam Flows
- Tides range and height
- Water depth
- Cross-section integration
- Time

Using these data, the design contractor will develop relationships between concentrations and other factors determined to affect concentrations. Using this relationship, the design contractor will determine the mean and UCL of the baseline concentration and loads expected under each conditions. During the remedial operations, daily measurements of TSS and COCs obtained at the far-field stations will be compared to the baseline values to determine whether the releases related to remedial activities are in excess of the load-based criteria.

4.2.2 Estimation of Loads during Dredging and Capping

4.2.3 Cumulative Loads at End of Construction

4.2.4 Projected Long-Term Loads After Construction

4.2.5 Near-Field and Far-Field Action Levels

4.2.6 Monitoring Plan

4.3 Reporting and Notification

4.3.1 Routine Reporting

4.3.2 Contingency Reporting

4.4 Additional Studies/Evaluations

4.4.1 Turbidity and TSS

5. Productivity Performance Standards for Dredging and Capping

This chapter describes the technical basis for the Productivity Standards for Dredging and Capping and how the standards will be implemented. All volumes mentioned are in-situ unless otherwise specified.

5.1 Basis for the Productivity Standards for Dredging and Capping

5.1.1 Technical Background and Approach

A component of the Selected Remedy is to remove sufficient contaminated sediment from the river to accommodate a bank-to-bank engineered cap and to allow for the continued commercial use of the federally-authorized navigation channel in the lower 1.7 miles of the river in order to meet the objectives stated in the ROD (EPA, 2016). In the ROD, the project duration of the selected remedy was estimated at approximately six years. The estimate assumed the following:

- Removal of approximately 3.5 million cubic yards of contaminated sediment
- Placement of a sand cap with a thickness of approximately 2 feet
- Placement of armor in approximately 110 acres of the river
- An annual consecutive period of 17-weeks of no in-river activities (i.e., dredging or capping) to accommodate fish windows
- Up to 3-weeks of non-consecutive downtime every year due to equipment breakdown and weather-related delays
- Construction of a processing facility sized to handle approximately 739,200 cubic yards per year (an average of 3,850 in-situ cubic yards per day).

The average dredging production rate used to calculate the duration of the selected remedy was based on a reach-by-reach analysis, which evaluated bridge and river constraints, equipment sizing and material transport approaches. The average capping production rate was assumed to be similar to that of dredging since the same bridge and river constraints apply to both operations.

<u>Bridge Constraints in the Lower Eight Miles of the Lower Passaic River</u>
The lower 8.3 miles of the Lower Passaic River is crossed by 13 bridges of various heights. Some of the bridges can only be opened with extreme difficulty to allow the passage of river vessels, because they are heavily used for commuter rail (e.g., Amtrak's Dock Street Bridge) or automobile traffic, or because of their age and condition. A summary of the bridge clearances associated with each bridge is presented in Table 5-5.

Table 5-5 Bridge Locations and Clearances in the Lower 8.3 Miles of the Passaic River

Reach	Name of Bridge	River Mile	Bridge Clearance			Observations
			Horizontal (feet)	Vertical MHW (feet)	Vertical MLW (feet)	
RM 0 – 2.6	Central Railroad of NJ Bridge	1.2	145	NA		Swing span removed
	Routes 1&9 Lincoln Highway Bridge	1.8	300	40	45.5	

	Pulaski Skyway	2	520	135	140.5	
	Conrail's Point-No-Point Railroad Bridge	2.6	103(N)/104(S)	16	21.5	
RM 2.6 - 5.7	NJ Turnpike Bridge	2.7	352 (319)[1]	100	105.5	
	Jackson Street Bridge	4.6	72	18[2]	23.5 (20[2])	
	Amtrak's Dock Street Bridge	5	200	24	29.5	
	Bridge Street Bridge	5.6	80	7	12.5	Low vertical clearance
RM 5.7 - 6.1	NJTRO Newark-Harrison Bridge	5.8	77	15	20.5	
	Route 280 Bridge	5.8	200	35	40.5	
	Clay Street Bridge	6.1	75	8(15)[3]	13.5	Low vertical clearance
RM 6.1 - 8.1	Fourth Ave Conrail	6.3	126	7	12.5	Maintained in open position
RM 8.1 - 8.3	NJTRO West Arlington Bridge	8.1	70 45(E)/48(W)[4]	36/35(W)[4]	41.5/40.5(W)	Narrow horizontal clearance

1. NOAA Chart 12337 = 319 feet, USACE (2010) = 352 feet.
2. USACE (2010) Low Tide = 20 feet, NOAA Chart 12337 High Tide = 18 feet
3. Current Vertical Clearance (MHW) is 8 feet, may fix in place at 15 feet in future
4. Looking from seaward to channel. In NOAA, horizontal clearance for Swing bridge = 45ft on east side of channel and 48ft on west side of channel, horizontal clearance for fixed span = 70ft on west side of channel; vertical clearance for swing bridge = 36ft, vertical clearance for fixed span = 35ft on west side of channel.

Bridges along the lower 8.3 miles of the Lower Passaic River may constrain navigation due to low vertical clearance or narrow horizontal clearance. Based on experience with the dredging of the Hudson River PCBs Superfund Site, EPA expects that movement of vessels beneath bridges with a vertical clearance of greater than 18 feet will be feasible without opening them, assuming low profile tugs (with retractable pilot houses) and barges are used. Additional logistical planning may be needed to stage and schedule barge movement with the tides for bridges that only have the required clearance during low tide. Of the 13 bridges in the lower 8.3 miles, two bridges (i.e., Bridge Street Bridge and the Clay Street Bridge) would present the greatest challenges to navigation as a result of vertical clearances less than 18 feet under mean low water conditions.

In addition, within the federal navigation channel, the USACE recommends a horizontal clearance (i.e., the distance between the vertical supports [piers]) of approximately 3 times the vessel beam for one-way ship traffic; recommended values vary from approximately 2.5 to 5.5 times the ship beam depending on the channel cross-sections and maximum current (USACE, 2006). The NJTRO West Arlington Bridge has a horizontal clearance of less than 50 feet that could restrict the size of the equipment that can safely navigate through the bridge.

Various alternative sediment transport options are potentially feasible to minimize implementation issues associated with bridge clearance limitations, including hydraulic dredging or bypass pumping and the use of smaller barges for mechanical dredging. A detailed look at dredged material transport options and productivity estimates is presented in the ROD and can be found in Appendix V of the ROD, Section III.C.1 “Review and Evaluation of Options Associated with Bridge Openings” and Section III.C.3 “Assessment of Project Schedule and Productivity Estimates.”

Dredging Production and Sequence Presented in the ROD

The evaluation presented in the ROD assumed mechanical dredging of 3.5 million cubic yards with a combination of barge transport and bypass pumping between RM 6.1 and RM 5.7. The river was divided into 5 reaches based on access restrictions (refer to Table 5-6). The dredging rates were then adjusted depending on the characteristics of the bridges within each reach.

Table 5-6 Reach by Reach Analysis

Reach	Dredging Rate (cy/day)	Dredging Rate Constraint
RM 0 to RM 2.6	1,100 to 3,850	Varies to maintain a cumulative total 3,850 cy per d ay project production rate (sum of rates for all reaches dredg ed simultaneously)
RM 2.6 to RM 5.7	1,100[1]	Limited by barge size (approximately 1,500 to 1,600 tons capacity), in turn constrained by bridge vertical c learance (20ft)
RM 5.7 to RM 6.1	500	Constrained by bridge vertical clearance limitation s (10ft), and limited space for dredging equipment
RM 6.1 to RM 8.1	1,100	Limited by barge size that can transit downriver re aches (RM 2.6 to RM 5.7)
RM 8.1 to RM 8.3	500	Constrained by bridge horizont al clearance at RM 8.1

1. When sediment processing area capacity allows, may use a 500 cy/day dredge platform in conjunction with the 1,100 cy/day dredge platform increasing the daily dredging rate to 1,600 cy.

A sequence of work was assumed so that the dredging rates in the different reaches were balanced in order to maintain a constant removal rate to facilitate sizing and consistent operation of the sediment processing facility. The completion of dredging (and capping) activities was estimated to take approximately six construction seasons (refer to Figure 5-1). The dredging sequence assumed in the ROD is one example of how dredging operations can be sequenced and will be referred to as Sequence M1 in this document.

Capping Production and Sequence Presented in the ROD

Project durations presented in the ROD assumed that both capping and dredging production rates would be similar because the same bridge and river constraints would apply for both operations. It was assumed that approximately one week or less would be required for the bathymetric survey and to obtain approvals in a certification unit after dredging in that area was completed. The cap would be placed in one or more lifts after the approval process and as soon as practicably possible (see Section 2.2).

The sediment removal volume and removal sequencing is expected to be revised during the remedial design; hence, establishing a minimum annual productivity quota is imperative to determining measurable targets for the remedial work. In addition to bridge and river constraints, factors influencing dredging productivity and project duration include:

- Dredging Removal Method, Rates, and Sequence
- Sediment Processing Facility Size and Location
- Volume of Sediment to be Removed
- Length of Fish Windows
- Equipment Breakdown and Weather-Related Delays

On the other hand, factors affecting capping productivity include:

- Cap Placement Method, Rates, and Sequence
- Distance Between Capping and Dredging Operations
- Length of Fish Windows
- Equipment Breakdown and Weather-Related Delays

To support development of meaningful dredging and capping productivity standards, these factors were evaluated in detail as presented in Sections 5.1.2 and 5.1.3.

5.1.2 Supporting Analysis for Dredging Productivity

<u>Dredging Removal Method, Rates, and Sequence</u>
{Add paragraph summarizing mechanical vs hydraulic dredging – summarized RS analysis}

Based on a review of the hydraulic dredging in Fox River productivity data, hydraulic dredging can be accomplished at a faster rate than mechanical dredging (Tetra Tech 2012 and personal communication). Although, hydraulic dredging can deliver a higher production rate, overall production is limited by the throughput capacity of the processing facility. Experts from the dredging community (various dredging contractors and dredge manufacturers) noted that, in their experience, dredged material management activities associated with the processing facility such as material off-loading, dewatering and off-site transport were rate-limiting. The processing facility for the selected remedy (assumed in the ROD for cost estimating purposes) is sized to handle approximately 739,200 cubic yards per year (an average of 3,850 in-situ cubic yards per day, 6 days per week, 32 weeks per year). Since overall production is limited by the processing facility, the (more conservative) mechanical dredging production rate was used to asses feasibility regardless of the dredging approach (i.e., mechanical or hydraulic).

In the case of the lower 8.3 miles of the Lower Passaic River, the advantage of hydraulic dredging over mechanical is that hydraulic dredging production rates at the different reaches would not be limited by bridges and barge sizes (see mechanical dredging sequence M1 above). Since dredged material would be transported by pipelines rather than barges, the dredging rate would remain constant for all reaches, thereby, providing more flexibility on the sequence chosen for dredging. Figures 5-2 and 5-3 provide two examples of hydraulic dredging sequence and their corresponding daily production rates and durations (referred to as Sequences H1 and H2 in this document). It may be noted that the dredging duration for both approaches is approximately 4.8 years.

Conversely, the sequence for mechanical dredging would affect the dredging duration of the selected remedy. For example, changing the sequence for dredging RM 2.6 to RM 5.7 so that it occurs after dredging in RM 8.1 to RM 8.3 is completed would allow for greater flexibility and a shorter duration (refer to Figure 5-4). However, navigation around the increased amount of equipment needed at this reach may be challenging. This dredging sequence is another example of how dredging operations can be sequenced and will be referred to as Sequence M2 within this document. Mechanical dredging can also become a limiting factor and could increase the dredging duration if there is an increase in the dredging volume.

A comparison of the annual production rates for the two mechanical dredging sequences (M1 and M2) and the two hydraulic dredging sequences (H1 and H2) are presented in Figure 5-5. {Add discussion of Figure 5-5 – need to remark that with higher production rates remedy can be completed in 5 years and provide a capping season and discuss normalized rates for 6, 5.5, and 5 years}

Sediment Processing Facility Size and Location
{Add text summarizing how sediment processing facility size and location affect dredging productivity}

Volume of Sediment to be Removed
The volume of contaminated sediment to be removed was estimated to be approximately 3.5 million cubic yards in the ROD. This amount may increase or decrease during the design phase based on the final cap design. The productivity standard will have to be reassessed once a final removal volume is estimated to ensure that the productivity criteria are implementable.

Length of Fish Windows
Productivity evaluations presented in the ROD assumed that a fish window of 17 consecutive weeks (from about March 1 to June 30) would be implemented each construction season. This assumption is consistent with the fish window required for the Tierra Phase 1 and RM 10.9 removal projects (EPA, 2012 and CPG, 2013a). However, the length of the fish window may increase or decrease due to trends in river temperatures and the spawning periods of the different fish species. According to the ROD, consultation with various groups such as NOAA, UFWS, NMFS, and NJDEP and a fish migration study will be conducted during the design phase to determine the exact fish window. Table 5-8 summarized an analysis of the impacts to the dredging duration, for both the ROD sequence (M1) and alternate sequences (M2, H1, and H2), if the fish window were to be increased.

Table 5-8 Impact of Increasing Fish Window on Dredging Duration

Annual Production Rate (cubic yards)[1]	Dredging Weeks[2]	Fish Window Weeks	Decrease of Production Weeks	Dredging Duration (Years)	Construction Seasons (Years)	Sequence
739,200	32	17	0	5.58	6	M1
693,000	30	19	2	5.95	6	M1
669,900	29	20	3	6.16	6 or 7	M1
646,800	28	21	4	6.38	7	M1
739,200	32	17	0	4.79	5	M2, H1, H2
646,800	28	21	4	5.48	6	M2, H1, H2
600,600	26	23	6	5.9	6	M2, H1, H2
577,500	25	24	7	6.13	6 or 7	M2, H1, H2

1. Annual production rate calculated assuming a production rate of 3,850 cubic yards per 24-hr day over a period of 6 days per week. Number of dredging weeks for different fish window lengths is noted in the table.
2. Dredging weeks were calculated by subtracting the fish window period and an additional 3 weeks of non-consecutive downtime to allow for equipment breakdown and weather-related delays.

Dredging operations may be completed within 6 construction seasons for the mechanical dredging sequence presented in the ROD (M1) for fish window length increases of up to 3 additional weeks. For the revised mechanical dredging sequence (M2) and the two hydraulic dredging sequences (H1 and H2), dredging operations may be completed within 6 construction seasons for fish window length increases of up to 7 additional weeks. During the design phase of the project, fish migration, spawning studies and consultation with NOAA, USFWS, NMFS, and NJDEP will determine whether the 17 week fish window is appropriate or whether a reduction or increase of the length is warranted.

Breakdown and Weather-Related Delays

Productivity evaluations presented in the ROD assume 3 weeks of non-consecutive downtime to allow for breakdown and weather-related delays.

- Breakdown: Minor equipment breakdowns can generally be dealt with during scheduled work stoppages such as barge change-out times. Major equipment breakdowns can reduce the dredging productivity; however, generally enough contingency is provided in the dredging and processing equipment to reduce the impact. It is not expected that breakdowns of dredging and processing equipment will cause significant delays in the project schedule with the proper planning and maintenance of the equipment. However, mechanical or electrical breakdown of bridges that need to be opened to allow passage of vessels may cause delays as experienced during the environmental dredging pilot study (Louis Berger, 2012). A mechanical failure of the Conrail's Point-No-Point Railroad Bridge (at RM 2.6, see Table 5-5) caused a mobilization delay during the dredging pilot. While this delay did not affect the start of the pilot study, the dredging contractor had insufficient time to properly set up a depth sensor which was fixed during a scheduled work stoppage. The potential for delay caused by bridge opening issues may be minimized with material transport approaches that reduce the number of bridge openings such as bypass pumping, custom-sized equipment or hydraulic dredging. See Appendix V of the ROD, Section III.C.1 "Review and Evaluation of Options Associated with Bridge Openings" for more information.
- Weather-related Delays: During the 2005 Environmental Dredging Pilot Study, one day was lost due to inclement weather and the operations had to be extended an additional day beyond the planned schedule. However, this postponement of dredging activities was due to safety concerns for monitoring personnel – the dredging contractor was prepared to work. {Add text on temperature related down time – e.g. icing}. The RM 10.9 Removal final design report (CPG, 2013a) presented best management practices involving suspension of operations when 1) river velocity is above the effective velocity limits of a silt curtain system, which is 2 knots or approximately 3.5 feet per second (fps), and 2) for significant storm event flows, which were defined as 6,000 cubic feet per second or greater based on historical data. {Add text from contractor/experts about safe operation velocities and add discussion of approximate velocities during the dredging pilot}. An analysis of river flows and velocities during normal and storm conditions is presented in Attachment E "Evaluation of Flow and Storm Surge Conditions Not Suitable for In-River Operations". This analysis shows that river velocity rather than river flow should be used to determine suitable conditions for in-river operations. Table 5-9 presents the number of days that could potentially be impacted by river velocities. {Add discussion of table 5-9}

Table 5-9 Potential Number of Days Impacted by River Velocities

		Maximum Surface Velocity > 3.5 fps	Maximum Surface Velocity > 4 fps

Reach (River Mile)	Total Number of Dredging Years[1]	Days of Occurrence per Year	Potential Number of Impacted Days[2]	Days of Occurrence per Year	Potential Number of Impacted Days[2]
0-1	1.5-2.1	3.5	7.5	0.2	0.5
1-2	0.9-1.3	38	50	4.2	5.5
2-3	0.3-0.6	29	18	2.2	1.5
3-4	0.4-1.2	39	47	3.4	4
4-5	0.3-1.2	64	77	11	13
5-6	0.3-1.1	17	19	2.5	3
6-7	0.3-1	3.5	3.5	1.8	1.8
7-8.3	0.4-1.6	8.7	13	4.4	7

1. Number of years was calculated using the total volume per river mile and dividing it by the daily production rate of 3,850 cy (minimum value) and by the daily production rate in the ROD and above in Table 5-6 (to get the maximum value). The number of years is based on a 35 week year; the 3 weeks of down-time are not included.
2. Potential number of impacted days was calculated by multiplying the maximum number of dredging years by the days of occurrence per year.

{Add conclusions once task is completed – indicate whether 3 weeks of downtime is }.

5.1.3 Supporting Analysis for Capping Productivity

<u>Area Available for Capping</u>
{Provide conclusions of case studies and average capping rates. Include discussions with contractors ~ 1acre/day}

Average capping production rates are typically 1 acre per day. With the exception of the Kearny Point shoal areas, pre-dredging is necessary in the Lower Passaic River to prevent additional flooding. Therefore, capping rates will depend on how much area is available for capping each day (i.e., how much area is pre-dredged). Figure 5-6 presents the area pre-dredged or cleared per day by dredging operations at each reach. The figure was developed using information from the modeling and depicts the acres dredged versus the dredging days on a reach by reach basis. As can be seen from the various slopes, on a daily basis, 0.08 acres to 0.5 acres are pre-dredged per reach, with an average of 0.5 acres per day. Table 5-10 summarizes the approximate area that is available for capping per day for different sequences and dredging. This analysis indicates that capping operations can proceed at a much faster rate than dredging operations. Therefore, establishment of a capping productivity standard is not necessary. {Add text on timing of cap placement once modeling runs become available.}

Table 5-10 Summary of Area Available for Capping

Sequence		Average Capping rate (acres/day)
M1		0.5
H1		0.6
H2	Below RM 1.7	1
	Above RM 1.7	0.4

5.2 Implementation of the Productivity Standards for Dredging and Capping

5.2.1 Productivity Threshold Criteria

This section provides six options for dredging productivity. The options are divided into three groups: annual, cumulative, and final capping season. Currently, the recommended standard is Options 2a and 3a, which is reflected in the statement of standards in Section 2.4.

<u>Constant Annual Production Rate</u>

<u>Option 1a – Fixed Minimum Annual Productivity</u>

Based on Figure 5-5 an annual production rate of 600,000 cubic yards a year would be a reasonable standard. At an annual production rate of 600,000 cubic yards, the dredging duration would be 5.90 years or six construction seasons. Since the standard would require that the annual production rate remain constant, an increase in the length of the fish window would require an increase in the daily production rate, as shown in Table 5-11.

Table 5-11 Impact of Increasing Fish Window on Dredging Duration if Annual Production Held Constant

Maximum Daily Production Rate (cubic yards)	Annual Production Rate (cubic yards)	Dredging Season (Weeks)	Fish Window (Weeks)	Decrease of Production Weeks	Dredging Duration (Years)	Construction Seasons (Years)
3,100	600,000	32	17	0	5.90	6
3,200	600,000	31	18	1	5.90	6
3,300	600,000	30	19	2	5.90	6
3,600	600,000	28	21	4	5.90	6

Note: The maximum daily production rate is rounded to the nearest 100 cubic yards.

However, since the annual production rate remains constant, increasing the volume would affect the dredging duration. Table 5-12 illustrates that a volume increase due to additional cap thickness would cause the dredging duration to exceed 6 years.

Table 5-12 Impact of Increasing Cap Thickness on Dredging Duration if Annual Production Held Constant

Maximum Daily Production Rate (cubic yards)	Annual Production Rate (cubic yards)	Dredging Season (Weeks)	Additional Dredging Depth (feet)	Dredging Duration (Years)	Construction Seasons (Years)
3,100	600,000	32	0	5.90	6
3,100	600,000	32	0.5	6.58	7
3,100	600,000	32	1	7.26	7 or 8

Note: The maximum daily production rate is rounded to the nearest 100 cubic yards.

<u>Option 1b – Annual Productivity Based on Fixed Duration</u>

The dredging duration is fixed at 6 construction seasons. Depending on the dredging volume calculated during the design phase, the annual production rate would be set accordingly and remain constant throughout all of the 6 construction seasons. The average annual production rate would be the total dredging volume divided by the 6 construction seasons for volumes within 20 percent of original ROD estimate. That would result in rates between 470,000 to 700,000 cubic yards per year. The overall completion schedule, if appropriate, would be adjusted in accordance with the EPA-approved remedial design schedule.

Table 5-13 Changes in Average Annual Production Based on Fixed Durations

Volume Increase/Decrease	Daily Production Rate (cubic yards)	Average Annual Production Rate (cubic yards)	Dredging Season (Weeks)	Construction Seasons (Years)
-20%	2,400	470,000	32	6
-15%	2,600	500,000	32	6
-10%	2,800	530,000	32	6
0%	3,100	590,000	32	6
+10%	3,400	650,000	32	6
+15%	3,500	680,000	32	6
+20%	3,700	710,000	32	6

Note: The daily production rate is rounded to the nearest 100 cubic yards.

Cumulative Annual Production Rate

Option 2a – This option includes a ramp-up year and reduced productivity in the final year to allow for capping in the second half of the season. This option provides flexibility for unexpected delays, volume increases and annual fluctuations in fish windows. It is estimated that dredging and capping would be completed within six construction season, as long as volume increases are no more than 10 to 20 percent. Table 5-14 presents the recommended cumulative annual production rates.

Table 5-14 Recommended Cumulative Annual Production Rates for Option 2a

Construction Season[1]	Average Annual Production Rate (cubic yards)	Cumulative Annual Production Rate (cubic yards)[2]
1	350,000[3] (10%)	350,000[3]
2	700,000 (20%)	1,050,000
3	700,000 (20%)	1,750,000
4	700,000 (20%)	2,450,000
5	700,000 (20%)	3,150,000
6	350,000[4,5] (10%)	3,500,000[4,5]

1. The overall completion schedule, if appropriate, will be adjusted in accordance with the USEPA-approved remedial design schedule.
2. The project must be designed and scheduled to meet the cumulative annual target volumes.
3. The minimum volume to be removed during the first season is approximately one-half a typical season's worth of work.
4. The target volume to be removed during the last season is approximately one-half a typical season's worth of work.
5. Productivity requirements and target volumes are based on the volume estimate of 3.5 million cubic yards, which is expected to be refined during the design phase of the project.

Option 2b – This option includes a ramp-up year, but no catch-up flexibility in the final year. This option is less flexible in addressing unexpected delays, volume increases or annual fluctuations in fish windows, but requires a lower average design production rate than Option 2a. It is estimated that dredging would be completed within six construction season, as long as volume increases are limited to no more than 5 to 10 percent. Table 5-15 presents the cumulative annual production rates.

Table 5-15 Cumulative Annual Production Rates for Option 2b

Construction Season[1]	Average Annual Production Rate (cubic yards)	Cumulative Annual Production Rate (cubic yards)[2]
1	300,000[3]	300,000[3]
2	640,000	940,000
3	640,000	1,580,000
4	640,000	2,220,000
5	640,000	2,860,000
6	640,000	3,500,000[4]

1. The overall completion schedule, if appropriate, will be adjusted in accordance with the USEPA-approved remedial design schedule.
2. The project must be designed and scheduled to meet the cumulative annual target volumes.
3. The minimum volume to be removed during the first season is approximately one-half a typical season's worth of work.
4. Productivity requirements and target volumes are based on the volume estimate of 3.5 million cubic yards, which is expected to be refined during the design phase of the project.

Final Capping Season

A final capping season can be incorporated into the standards as follows:

- Option 3a: Keep dredging production the same as presented in the options above (i.e., 1a, 1b, 2a and 2b) and add a season for final capping.
- Option 3b: Adjust dredging production so that project is completed in 5 years and final season is capping. Dredging can be completed in 5 years as shown in Figure 5-5, as long as the design volume does not exceed the ROD estimate by more than XXX percent and the other standards are consistently met.

5.2.2 Capping threshold criteria

As part of the cap design standard the design team should evaluate the following:

- Placing the cap at the end of each dredging season
- Placing the cap at the end of construction (final dredging season)
- Placing the cap immediately after dredging in that CU has been completed
- Placing the cap once an appropriate distance from the dredging operation has been determined that prevents deposition of resuspended sediments.

Since capping can occur at a much greater rate than dredging, it is not recommended to establish a capping rate, but rather, to establish a maximum time interval in which the CU can be left open between the end of dredging and the start of capping.

The expert panel suggested that once dredging is completed at a certification unit, the area be stabilized until the cap is placed. Stabilization may include a thin layer of sand between 3 to 6 inches in thickness, which would not be part of the cap. The cap would be constructed once dredging operations in the vicinity of the area do not pose a high risk of recontamination.

Based on the dredging sequence assumed for the ROD between 85 and 105 acres of river bottom will be available for capping each year (not including the Kearny shoals which were assumed to not require any pre-dredging). If capping occurs at a rate of approximately 1 acre per day, the area pre-dredged during one construction season could be capped within 14 to 18 weeks (approximately half of the construction season). The production schedule may be affected by the distance between the capping and dredging operations that will be evaluated when results from subtask 3.13 become available. This task will determine how far away from the dredge the resuspended sediments settle.

The capping productivity standard should require that all areas that are pre-dredged be capped before the start of the fish window.

5.3 Reporting and Notification

5.3.1 Routine Reporting

5.3.2 Contingency Reporting

5.4 Additional Studies/Evaluations

6. References

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7. Acronyms

A list of acronyms and definitions will be submitted in the draft version of the document.

Attachments